

Report from the Airplane Performance Harmonization Working Group

Issue: Engine Failure Contingency Procedures

Rule Section: FAR 121.189,135.379/JAR-OPS 1.495

1 – What is underlying safety issue to be addressed by the FAR/JAR? [Explain the underlying safety rationale for the requirement. Why should the requirement exist? What prompted this rulemaking activity (e.g., new technology, service history, etc.)?]

The pilot should be able to safely complete a takeoff and clear all obstacles beyond the runway end, even if power is lost from the most critical engine after the airplane passes the defined V1 go/no-go point. The most common procedure, to maximize takeoff weight when significant obstacles are present along the normal departure route, is to turn to a special engine out departure route in the event of an engine failure. The point, at which separation from the normal departure route is to occur, is pre-determined by an analysis of the climb out. Obstacles along this modified track (normal/ engine-out) are used to determine the maximum allowable takeoff weight for that runway.

Although the current FAR 121/135 requires that obstacles are to be cleared at all points by the net takeoff flight path, Part 25 rules determining the AFM flight path are based on engine failure at V1 and the assumption that the all engine and engine out flight paths are over the same track. Because the all-engine and engine-out tracks may not be the same, an engine failure should be considered at any point on the intended departure flight path when computing the maximum takeoff weight.

2 – What are the current FAR and JAR standards relative to this subject? [Reproduce the FAR and JAR rules text as indicated below]

Current FAR text:

Part 121

FAR 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

- (d) No person operating a turbine engine powered airplane may take off that airplane at a weight greater than that listed in the Airplane Flight Manual.
- (2) In the case of an airplane certificated after September 30, 1958 (SR422A, 422B), that allows a net takeoff flight path, that clears all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing the boundaries.

Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(d) No person operating a turbine engine powered airplane may take off that airplane at a weight greater than that listed in the Airplane Flight Manual.

- (2) In the case of an airplane certificated after September 30, 1958 (SR422A, 422B), that allows a net takeoff flight path, that clears all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing the boundaries.

Current JAR text:

JAR-OPS 1.495 Take-off Obstacle Clearance

- (a) An operator shall ensure that the net take-off flight path clears all obstacles by a vertical distance of at least 35 feet or by a horizontal distance of at least 90 m plus $0.125 \times D$, where D is the horizontal distance the aeroplane has traveled from the end of the take-off distance available or the end of the take-off distance if a turn is scheduled before the end of the take-off distance available. For aeroplanes with a wingspan of less than 60 m a horizontal obstacle clearance of half the aeroplane wingspan plus 60 m, plus $0.125 \times D$ may be used. (See IEM OPS 1.495(a).)
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- (f) An operator shall establish contingency procedures to satisfy the requirements of JAR-OPS 1.495 and to provide a safe route, avoiding obstacles, to enable the aeroplane to either comply with the en-route requirements of JAR-OPS 1.500, or land at either the aerodrome of departure or at a take-off alternate aerodrome (See IEM OPS-1.495(f)).

2A – If no FAR or JAR standard exists, what means have been used to ensure this safety issue is addressed? [Reproduce text from issue papers, special conditions, policy, certification action items, etc., that have been used relative to this issue]

N/A

3 – What are the differences in the FAA and JAA standards or policy and what do these differences result in? [Explain the differences in the standards or policy, and what these differences result in relative to (as applicable) design features/capability, safety margins, cost, stringency, etc.]

The FAR implies that obstacle clearance should be provided at all points by the net takeoff flight path but only addresses an engine failure at the V1 go/no-go point. Also, the Airplane Flight Manual only addresses takeoff with engine failure at the V1 go/no-go

point. Consequently, most FAA operators do not consider an engine failure beyond V1 when analyzing departures.

The JAR is more specific in requiring operators to provide contingency procedures to ensure a safe route, avoiding obstacles, to enable the compliance with departure or en-route rules. JAR-OPS 1.485 also requires the operator to ensure that performance data, acceptable to the Authority, is available for consideration of engine failure in all flight phases.

4 – What, if any, are the differences in the current means of compliance? [Provide a brief explanation of any differences in the current compliance criteria or methodology (e.g., issue papers), including any differences in either criteria, methodology, or application that result in a difference in stringency between the standards.]

The FAR does not contain a specific standard for takeoff performance with an engine failure occurring beyond V1, therefore, there is no means of compliance. However, the FAA draft AC 120.XXX does provide a means of compliance that is basically the same as the JAR by specifying development of special engine-out departure procedures.

5 – What is the proposed action? [Describe the new proposed requirement, or the proposed change to the existing requirement, as applicable. Is the proposed action to introduce a new standard, or to take some other action? Explain what action is being proposed (not the regulatory text, but the underlying rationale) and why that direction was chosen for each proposed action.]

The proposed action is to harmonize to the JAR standard. The requirement, for operators to take into account obstacle clearance following an engine failure at any point on the intended takeoff flight path, would be added to Parts 121 and 135 of the FAR.

The proposal would add, as a new 121.189(g) and 135.379(g), a requirement to establish procedures to maintain the obstacle clearance specified by 121.189(d)(2) and 135.379(d)(2) following an engine failure occurring at any point on the intended takeoff flight path. Although this text is different than the JAR text, the intent and the results are the same.

For many airports with no particular high obstacle vulnerabilities (e.g. Dallas-Ft Worth, Minneapolis, Amsterdam), there may not be a need to perform a detailed analysis or develop special procedures. For others with limited vulnerability (e.g. Denver, Milan), the operator might have to provide a simple procedure to turn the airplane away from the terrain. In other cases (e.g. Reno, Innsbruck), a detailed analysis may be required to determine critical engine failure points and escape routes along the intended takeoff flight path.

For each proposed change from the existing standard, answer the following questions:

6 – What should the harmonized standard be? [Insert the proposed text of the harmonized standard here]

The proposed amended FAR Parts 121, and 135 standards are specified below.
(Note: No changes are being proposed for the JAR.)

FAR Part 121

FAR 121.189 Airplanes: Turbine engine powered: Takeoff limitations.

(d) No person operating a turbine engine powered airplane may take off that airplane at a weight greater than that listed in the Airplane Flight Manual.

(2) In the case of an airplane certificated after September 30, 1958 (SR422A, 422B), that allows a net takeoff flight path, that clears all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing the boundaries.

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(g) No person operating a turbine engine powered airplane may take off that airplane unless procedures have been established to maintain the obstacle clearance required by 121.189(d)(2) following an engine failure occurring at any point on the intended takeoff flight path.

FAR Part 135

FAR 135.379 Large transport category airplanes: Turbine engine powered: Takeoff limitations.

(d) No person operating a turbine engine powered airplane may take off that airplane at a weight greater than that listed in the Airplane Flight Manual.

(2) In the case of an airplane certificated after September 30, 1958 (SR422A, 422B), that allows a net takeoff flight path, that clears all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries and by at least 300 feet horizontally after passing the boundaries.

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(g) No person operating a turbine engine powered airplane may take off that airplane unless procedures have been established to maintain the obstacle clearance required by 135.379(d)(2) following an engine failure occurring at any point on the intended takeoff flight path.

7 – How does this proposed standard address the underlying safety issue (identified under # 1)? [Explain how the proposed standard ensures that the underlying safety issue is taken care of.]

The proposed standard requires the operator to account for obstacle clearance, following an engine failure at any point on the takeoff flight path. The operator may need to reduce the takeoff weight at certain airports or schedule a turn when planning an engine failure beyond V1.

8 – Relative to the current FAR, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Explain how each element of the proposed change to the standards affects the level of safety relative to the current FAR. It is possible that some portions of the proposal may reduce the level of safety even though the proposal as a whole may increase the level of safety.]

The proposed standard would increase the level of safety by mandating the consideration of an engine failure anywhere along the intended takeoff flight path.

9 – Relative to current industry practice, does the proposed standard increase, decrease, or maintain the same level of safety? Explain. [Since industry practice may be different than what is required by the FAR (e.g., general industry practice may be more restrictive), explain how each element of the proposed change to the standards affects the level of safety relative to current industry practice. Explain whether current industry practice is in compliance with the proposed standard.]

The proposed standard would increase the level of safety, especially, at airports where high terrain is a problem. Although FAR operators do plan an engine failure at the V1 go/no-go point by use of the Airplane Flight Manual, most do not consider an engine failure beyond V1. For operators who currently apply the standards written in the FAA draft AC 120.XXX, the level of safety would remain the same.

10 – What other options have been considered and why were they not selected? [Explain what other options were considered, and why they were not selected (e.g., cost/benefit, unacceptable decrease in the level of safety, lack of consensus, etc.) Include the pros and cons associated with each alternative.]

The alternatives would be to harmonize on the current FAR standard or retain the non-harmonized standards. Harmonizing on the current FAR standard would involve removing the contingency procedure requirement from the JAR. This was unacceptable to the JAA, as it would result in a decrease in safety relative to the current JAR. Retaining the current non-harmonized standards was unacceptable because it would not address the economic issue of the non-level playing field. Also, it is recognized in the FAA draft AC 120.XXX that it is necessary to account for an engine failure at any point on the intended flight path, thus, showing consensus on this issue.

11 – Who would be affected by the proposed change? [Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.]

Operators and manufacturers of transport category airplanes would be affected by the proposed change. Airplane manufacturers would be requested by operators to provide supplemental performance data not currently carried in the Airplane Flight Manual. Airplane operators would need to reanalyze airports with high terrain and man made obstacles to determine the critical engine failure point occurring on the flight path beyond

V1. Some operators would need to either reduce the takeoff weight or provide a special turn procedure to comply with the proposed rule change.

12 – To ensure harmonization, what current advisory material (e.g., ACJ, AMJ, AC, policy letters) needs to be included in the rule text or preamble? [Does any existing advisory material include substantive requirements that should be contained in the regulation? This may occur because the regulation itself is vague, or if the advisory material is interpreted as providing the only acceptable means of compliance.]

None.

13 – Is existing FAA advisory material adequate? If not, what advisory material should be adopted? [Indicate whether the existing advisory (if any) is adequate. If the current advisory material is not adequate, indicate whether the existing material should be revised, or new material provided. Also, either insert the text of the proposed advisory material here, or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, policy, Order, etc.)]

Current FAA advisory material is non-existent. An Advisory Circular should be provided that contains instructions on the development of “all engine” and “engine out” takeoff flight paths. These same instructions should also be incorporated into the appropriate JAA IEM to ensure harmonization. The instructions should include an “all engine” gross flight path to an engine failure point beyond V1, then continuing on an “engine out” net flight path to clean up and complete the final segment to the en-route altitude. Other variations should be considered such as initiating a turn at the engine failure point to deviate from the normal departure route to a special engine failure route where obstacles are safely avoided or cleared vertically. The option to return for a landing rather than continue on the flight path should also be considered in the instructions.

Where the normal departure route is not well defined with a departure procedure or standard instrument procedure and is controlled by ATC through the use of radar vectors, it is assumed that ATC is responsible from that point on for safely guiding the aircraft over the terrain to the en-route altitude or to return for a landing. But, up to the point of receiving a radar vector the operator is still responsible for development of the takeoff flight path.

Supplemental “all engine “ performance data such as provided in the aircraft manufacturers Community Noise Documents, Performance Engineers Manuals, and SCAP Programs may need to be updated and expanded to support the proposed standard. All engine performance should remain as supplemental data and not be published in the Airplane Flight Manual.

Because the FAR proposed standard requires obstacle analysis to be performed for distances far in excess of current practice, it will not be possible to fully comply with the rule until all regulatory agencies provide “takeoff runway surveys” and “special topographical charts”, equivalent to ICAO Type A and Type C obstruction charts.

14 – How does the proposed standard compare to the current ICAO standard?

[Indicate whether the proposed standard complies with or does not comply with the applicable ICAO standards (if any)]

The proposed FAR standard complies with the relevant ICAO standards in Annex 6.

15 – Does the proposed standard affect other HWG's? [Indicate whether the proposed standard should be reviewed by other harmonization working groups and why.]

N/A

16 – What is the cost impact of complying with the proposed standard? [Please provide information that will assist in estimating the change in cost (either positive or negative) of the proposed rule. For example, if new tests or designs are required, what is known with respect to the testing or engineering costs? If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs? In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.]

There would not be a cost impact for those operators who currently account for the proposed FAR standard. The operational cost to operators, who do not account for the proposed standard, would be small because most of the time a turn procedure can be scheduled to avoid obstacles. However, there is the possibility of a loss in payload at certain critical airports with high terrain. Other costs would include the purchase of performance data, obstruction charts, and manpower to program and analyze takeoff flight paths. The cost impact to airplane manufacturers would be for updating and expanding or developing new supplemental performance data to comply with the rule change. The cost impact to the regulatory agencies would be for providing takeoff runway surveys at all airports and the development of special topographical charts at airports where significantly high terrain or man made obstacles exist.

17 – If advisory or interpretive material is to be submitted, document the advisory or interpretive guidelines. If disagreement exists, document the disagreement.

The FAA draft AC 120.XXX is to be submitted concurrently. It contains advisory material to support the proposed standard.

18 – Does the HWG wish to answer any supplementary questions specific to this project? [If the HWG can think of customized questions or concerns relevant to this project, please present the questions and the HWG answers and comments here.]

The proposed standard requires an operator to ensure adequate obstacle clearance along the intended takeoff flight path up to the point where the airplane can comply with the en-route limitations. Where the actual flight path differs from the intended flight path due to ATC vectoring, it is assumed that ATC is responsible for ensuring adequate obstacle clearance. The Working Group is concerned that this may not be a valid assumption.

19 – Does the HWG want to review the draft NPRM prior to publication in the Federal Register?

Yes. Review by the HWG is most important.